

Economic Theory and Conceptual Relationships Between Food Safety and International Trade

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Summary

The market has incentives to provide some degree of food safety, as firms depend on their reputations for repeat sales. However, the market generally does not provide the socially desirable amount of food safety for two reasons. First, consumers cannot determine how safe food is before buying it. Even when consumers purchase foods, they often cannot tell whether a particular food was responsible for making them ill or whether consuming it might have long-term health consequences. Food safety measures can increase costs for firms, and this lack of information reduces the incentives for a firm to provide safe food. Consumers will not necessarily be able to assign the appropriate credit or blame to firms that provide safe and unsafe food respectively. Indeed, when consumers learn of a food safety incident and the unsafe food cannot be attributed to a particular firm, consumers might simply stop consuming that type of food altogether.

Second, when consumers eat unsafe food and become ill, costs extend beyond consumers themselves to healthcare workers, employers, and family members. Consumers don't usually take these costs to others into account when they consume food. Thus, society would like consumers to devote even more resources to making certain that their food is safe in order to avoid these extra costs.

Government regulation is an attempt to increase the amount of food safety provided by the market, as the market alone will usually not provide the socially desirable level of food safety. Regulations can specify particular processes that a firm must use to produce food, or they can simply specify a level of safety for the final

food product. The latter are generally considered more efficient, as they allow the firm to select the least expensive method of arriving at the desired product. Regulations often raise costs for firms, but consumers are often willing to pay more for safer food. However, firms might have a difficult time communicating improved safety to consumers.

When countries trade internationally, the same issues arise, with a few additional concerns. Regulations might differ across countries, as countries have different types of regulations, different levels of tolerance for food safety risks, different costs of producing safer food, and different levels of accidental contamination. If a regulation imposed by the government of one country is more stringent, its firms will have higher costs and may be unable to sell their goods as cheaply as foreign firms not subject to the regulations. Consumers will pay more for safer food, but the firm's ability to communicate its food safety level—and the consumers' inability to take social costs into account—can leave the domestic firms at a disadvantage. These regulatory differences can create conflicts across countries.

When countries disagree over food safety regulations for imports, several outcomes can occur. The domestic country can ban less regulated foreign foods. If the foreign producers really cannot provide the safer food as cheaply as domestic firms, this could benefit consumers. However, if foreign firms could provide food that is cheap and safe, consumers lose from a ban. If the foreign firms decide that the value of the domestic country's market is high enough, the foreign firms can adopt the domestic country's costlier food safety regulations. If these regulations spread throughout the foreign country's industry, this can improve food safety for the foreign country's own consumers. Finally, the countries can negotiate their way to a compromise solution, if both feel that the costs they must incur are worth the benefit of maintaining the trading relationship.

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Introduction

This chapter discusses the basic economic theory behind food safety regulation, and its predicted effects on trade. Food safety issues are becoming increasingly important in the arena of international food trade. As countries begin to lower agricultural tariffs and become increasingly integrated into world markets, they purchase more food from abroad. As consumers grow wealthier, they also focus more on the attributes of their food, its safety, nutrition, and environmental friendliness. Increased income can mean an increased willingness to pay for such characteristics.

Consumers demand food safety, and food producers are willing to provide it. However, consumers often lack information about products that they buy, and might not consider social costs, like lost workdays resulting from a foodborne illness, in their purchasing decisions. This incomplete information, coupled with the costliness of some food safety provisions, can mean that the government needs to regulate food safety.

Indeed, most nations have laws that regulate the safe production of food within their borders, but no country has jurisdiction over production outside of its borders. A country can regulate the products entering its borders, but enforcing these standards is difficult and costly, as it requires sampling and testing many shipments. Consumers therefore consume not only food from abroad, but also the services of other countries' food safety regimes. The desired level and form of food safety regulation may vary among countries, and exporting firms might have difficulty complying with multiple safety regimes. Differences in food safety regulations can lead to trade conflicts, but can also lead to increased dialogue on food safety standards. Some conflicts over food safety lead to reductions in trade, while other conflicts are settled amicably. Sometimes, conflicts can even lead to improvements in food safety, as firms comply with the stricter safety regimes of their trading partners.

Demand for Food Safety

Food Safety is Valued by Consumers

Consumers value a safe food supply. Since food is a necessity, consumers value knowing that their food is free of toxins, foreign material, and pathogens. Food

safety concerns have increased as wealth has risen. Now that many consumers in the industrialized world have adequate quantities of food, they (or their governments) can spend resources to ensure that their food is safer. For example, Hayes et al. (1995) found that U.S. consumers were willing to pay a premium of 15 to 30 percent per meal to reduce their risk of becoming ill from their meal, while a number of studies cited by Baker (1999) found that consumers are willing to pay a premium for reduced pesticide residues in produce. Another study found that the premium consumers were willing to pay for food with low pesticide residues increased with income (Huang et al., 2000, 1999). In a number of experiments and surveys, consumers have indicated that they would be willing to pay more for food with lower risks of disease; however, these experiments might not reflect how consumers will actually behave in a market setting, as consumers' attitudes on surveys sometimes differ from their documented behavior at the cash register (Caswell, 1998). Food safety scares, like the Bovine Spongiform Encephalopathy (BSE or "mad cow disease") problem in the European Union (EU), or the *E. coli* outbreak in the Western U.S., have raised awareness about food safety issues. Additionally, food travels long distances from producer to consumer, and many foods are perishable. Modern food processing facilities, refrigerated transport, and research on temperatures, pathogens, and toxins have all improved food safety. As consumers know that such technologies are available, they will likely hold producers to a high standard.

Consumer Demand Reflects Only Some Benefits of Food Safety

Consumers can lack adequate information about their food purchases, preventing them from demanding the level of food safety they would choose if they had complete information.² Additionally, even if consumers have adequate information, their individual purchases may not reflect the desire of the wider society for food safety.

² When an economic agent does not know which of several possible outcomes (safe food, unsafe food) will result from a transaction, economists say the market is characterized by *imperfect information*. When one party to a transaction does not know as much about the good being exchanged as the other does (for example, a consumer does not directly observe how meat is handled), economists say the market is characterized by *asymmetric information*.

Food Safety Is Not Always Observable

Consumers cannot always readily observe the safety level of their food. A consumer usually cannot know whether food is contaminated until after purchasing it (Segerson, 1999; Caswell, 1998). Even if the consumer becomes ill from eating food, linking the illness to a particular food out of many consumed is often difficult (Segerson, 1999; Buzby et al., 2001; Caswell and Mojdzuska, 1996). Indeed, if the food is contaminated with toxins, like carcinogens, the consumer might be not be able to observe any adverse effects for many years, if ever, and might not be able to attribute any adverse health consequences to a particular food (Antle, 1996).³ Thus, firms have less incentive to provide food safety than they would if food safety were directly observable by the consumer prior to purchase.

Consumers Don't Consider Food Safety Effects on Society as a Whole

Consumers may not demand as much food safety as would be *socially* desirable, neglecting to take all the social costs of their purchases into consideration (Segerson, 1999, Golan et al., 2001). Inadequate food safety can result in illness, which imposes private costs on the consumer, but which also creates social costs in the form of additional resources allocated to medical care and lost workdays. For instance, outbreaks of *E. coli* O157:H7 in fast food restaurants during the early 1990s created clusters of illness in several Western States, with over 700 people affected. Several victims died, and many patients experienced pain and suffering. Some spent costly stays in intensive care units or visited emergency rooms, and some might experience lifelong health problems, with long-term implications for health-care resources (Buzby, 2002; Foulke, 1994). In such cases, the patients' relatives had to put aside other activities in order to care for them. In addition, public health resources had to be mobilized to trace the source of the outbreak.

Thus, health care resources, employers, and other sectors of the economy share the costs of inadequate food safety with the original consumer of the unsafe food. This reduces both producers' incentives to produce safe food and consumers' incentives to consume safe food, because neither group bears the full costs of their

actions. Even if producers matched the food safety they provide with the amount that consumers demand, a more socially beneficial outcome would occur if producers' provision of food safety met the demand of consumers plus the demand of health care resources, employers, public health departments, and other affected sectors of the economy.

Implications of Food Safety Demand for Firms

Since consumers demand some degree of food safety, firms have an incentive to supply safer food (Holleran et al., 1999). Reputations for providing safe food are valuable assets that firms have an incentive to protect. A firm can develop an edge over its competitors if it produces food using a technique known to enhance food safety (Reardon and Farina, 2001). Likewise, a firm can suffer increased costs or a loss of sales and equity, sometimes permanently, if someone becomes ill from eating one of its products (Buzby et al., 2001; Dolan and Humphrey, 2000; Henson and Northen, 1998; Segerson, 1999; Thomsen and McKenzie, 2001). Odwalla, a "natural" juice company, lost millions in sales and suffered a stock price decline of 68 percent when customers contracted *E. coli* from drinking its apple juice (Buzby et al., 2001; *San Jose Business Journal*, 1997). In another instance, Perrier, a leading mineral water company, lost 50 percent of its U.S. market share when one of its shipments was contaminated with benzene (Kunreuther and Slovic, 2001). Richards and Patterson (1999) find that negative publicity about the safety of a food product has a very persistent effect on prices.

Food Safety Can Be Costly to Supply

Implementing food safety standards can increase costs for firms. If food processors need, for example, to increase the cooking temperatures for their foods, they will need to pay more for energy, and will need to cook each unit of product longer, perhaps raising labor costs. If firms are required to use sterile packaging, they might have to add more steps or inputs to their assembly line. If certain pesticides are banned, farmers might have to use less effective ones, thus losing a larger percentage of their crop to pest damage.

However, some standards might not raise costs much at all. For example, some of the more toxic pesticides can be replaced with less toxic ones for similar prices. Jensen et al. (1998) found that improving food safety in

³ When a good has a characteristic (e.g., overall effects on longrun health) that is not directly observable even after the buyer has purchased and consumed it, economists refer to that characteristic as a *credence attribute*.

the meat industry raised costs for producers and that costs varied with the particular safety option chosen. Antle (1999) cites a number of studies that quantify the costs of complying with various food safety regulations. Ollinger and Mueller (2003) find that implementing HACCP (Hazard Analysis and Critical Control Points) systems in meat-processing plants added just under one cent per pound to the cost of meat processing.

Firms have incentives to protect their reputations, and so might implement state-of-the-art food safety practices without any prodding from the government. Additionally, as consumers might be willing to pay more for food that they perceive as safer, firms have another incentive to implement food safety regimes. The higher prices consumers are willing to pay could compensate firms for the costs of food safety provision. A firm will adopt more stringent food safety practices if the cost is smaller than the resulting benefit to the firm in the form of reduced risk of losses, reduced liability, and higher consumer willingness to pay for the safer food.

Increasingly, food producers in wealthy countries engage in long-term contracting with their suppliers, and carefully vet those suppliers for food safety compliance. Some firms use international and third-party standards and certifiers in order to reduce the costs of verifying that suppliers are using safe production methods and to reduce the costs to suppliers (Henson and Northen, 1998). Segerson (1999) frames the problem slightly differently, noting that a firm will voluntarily improve food safety standards if the benefits to the firm, plus the decrease in damages a firm would have to pay to injured consumers from selling the safer food, outweigh the costs that the firm will have to pay to implement new safeguards. If the cost is greater than these benefits to the firm, firms might not adopt more stringent practices unless the government mandates them.

Imperfect Information Changes Incentives and Costs

Food safety levels are difficult to observe, and this can change the incentives for firms. If the firm perceives that consumers underestimate the chances of a food safety incident, then firms will produce more of the unsafe food than consumers would desire to purchase if they knew the risks (Segerson, 1999). Producers have less of an incentive to provide information about their products if they believe that consumers perceive

the products to be less harmful than they actually are (Zarkin and Anderson, 1992).

A special case of this inability to identify the source of illnesses occurs when a food safety problem is identified with a particular bulk product or products from a particular country. If a product produced by a particular firm makes some people ill, but that particular firm's goods are hard to identify in the marketplace, consumers may eschew all products in that category (chapter 5). This, in turn, can reduce other firms' desire to provide safe goods. Even if the other firms spend a great deal to provide safe food, consumers still might not buy their products if they cannot tell the difference between the safe products and the unsafe one produced by the firm with the lower standards. The firms spending money on food safety will not be compensated for their extra expenses by increased consumer demand or willingness to pay for their safer products (Akerlof, 1970; Antle 1996).

In chapter 5, Calvin notes several cases in which a particular type of fruit supplied by a particular supplier caused illness. In these cases, demand fell for that fruit across all suppliers, not just the one implicated in the food safety crisis. For instance, when imported strawberries caused an outbreak of salmonellosis in 1997, U.S. strawberry producers suffered a decrease in sales, despite the fact that their product was uncontaminated; the same happened to U.S. cantaloupe producers. In such cases, firms can take safety precautions and still suffer reduced demand; likewise, firms that do not take safety precautions impose costs not just on themselves, but on other firms as well. A firm might therefore think that safety precautions are not worth the costs, whereas they would be worth the costs if firms were responsible for the costs they impose on their fellow firms by damaging the reputation of the industry (Segerson, 1999).

Because consumers perceive a product generally, rather than a specific firm's product, as safe or unsafe, firms might find it in their best interest to implement safety standards for the industry as a whole (chapter 5). Industry standards are probably easier to achieve among a small number of firms. Coordination costs are kept to a minimum. Additionally, if some firm does not comply with the standards and sells unsafe food, the source of the food safety crisis is easier to pinpoint. With many firms, just negotiating a set of standards might be problematic, and enforcing the regulations might be more difficult if the source of unsafe food cannot be traced to a particular firm out of the many in the industry.

Even if a particular food product can be identified as the source of a food safety problem, several companies might have handled the product. A package of cheese might have been produced by one firm, shipped by another, and sold to the consumer by yet a third firm. If the cheese contained an unsafe number of pathogens, it might be difficult to determine whether the contamination resulted because the cheese was packaged improperly, or because the shipper or the retailer stored it improperly. This difficulty in assigning responsibility could again reduce the incentive to provide safe food.

Additionally, if the cheese is associated with the brand name of one of those firms, the other two are more insulated from the negative effects on their reputations, because the market will not effectively route demand away from their firms to other, safer firms. In such a case, the firm whose reputation is on the line would be willing to pay to have the other two firms provide adequate safety standards. Indeed, Henson and Northen (1998) note that this is the method preferred by UK retailers, who sell many items under their own name brands and therefore have a great deal to lose in liability and reputation if a food safety incident occurs. However, the unobservability of food safety makes it difficult for the firm that cares about its reputation to be certain of the work of the other two without carefully observing the whole production process. Therefore, they note, many retailers are asking suppliers for third-party certification of their production facilities, which reduces the monitoring costs for retailers.

Indeed, even in cases where firms might wish to provide food safety to their consumers, it is frequently difficult for them to do so, since they themselves find it hard to detect unsafe food. There are many types of food safety hazards, and contamination can occur at many different stages. Pathogens can also multiply over time, causing the danger to increase (Unnevehr and Jensen, 1996).

A Gap Exists between Socially Desirable and Market Outcomes

While economic theory suggests that firms should have an incentive to ensure that their products are safe from pathogens, toxins, and other hazards, these incentives are not always as strong as they need to be. The market outcome—that is, the intersection of supply and demand—can fail to achieve the efficient or socially desirable amount of food safety in two ways. The first source of market failure stems from the lack of con-

sumer information. The market supplies the level of safety that consumers can currently observe, not the level of food safety that consumers would want if they could observe all of the safety attributes of their food. In such cases, the market might produce too much of the unsafe food, and too little of the safe food.

The market's failure to provide the efficient level of food safety information can have substantial consequences. If consumers become concerned about the safety of the food supply, or particular food items, they will reduce their consumption of such items, thereby shrinking the food sector, or parts of it, below the amount of food that consumers would prefer to consume if they had adequate information about the safety of their purchases, and could tell the difference between safe and unsafe food (Akerlof, 1970). Also, if consumers are unable to evaluate the true risks of food consumption, they can experience more illness and incur more costs than benefits from consuming some foods. Henneberry et al. (1999) found that the amount of negative information that consumers received about pesticides on produce reduced the demand for some varieties of produce and increased the demand for others. Thus, consumers' concerns changed the composition of their diet, altering the pattern of production and consumption from what it would be if consumers had more information.

The gap between society's ideal level of food safety and that which consumers demand for themselves constitutes a second source of market failure. Ideally, society would like food safety to be provided to the point that reflects consumer demand for food safety, plus the demand of public health providers and employers for food safety. However, producers only have incentives to take consumer demand for a particular product into account, not the demand of the rest of society, as consumers' willingness to pay determines the price that the producer receives.

Countries as a whole incur substantial costs when food safety incidents occur. One USDA study indicates that five types of foodborne illness collectively cost the U.S. \$6.9 billion in 2000 (Roberts, 2001). Another USDA study, using simulations, indicates that implementing the Hazard Analysis and Critical Control Points (HACCP) program to reduce foodborne illness in meat and poultry resulted in economywide gains of \$9 billion, not including the benefits of reduced work days lost (Golan et al., 2000). Another study estimated that the benefits of implementing HACCP policies would be \$7-\$42 billion (Crutchfield et al., 1997).

These estimates generally exclude some costs, like pain and suffering and public health agencies' expenditures on foodborne disease.

Potential Ways to Close the Gap

Litigation

Consumers, and sometimes other members of society, can attempt to recover some of the costs of unsafe food from food producers by seeking redress through the court system. In countries with a functioning tort system, a party who is injured by consuming unsafe food can sue the firm that produced the food for damages (Antle, 1996). Such suits should provide incentives for firms to provide safer food rather than risk the court costs, damage costs, and negative publicity of a lawsuit, but the incentives are limited by the difficulty of proving conclusively that a producer's food caused the illness.⁴ Buzby et al. (2001) found that one-third of jury trials in food poisoning cases resulted in verdicts in favor of the consumer. Most cases were settled before they reached trial.

Education and Information Provision

Governments can use food safety education as an alternative to regulation. Requiring firms to disclose information about the foods they produce and educating the public about food safety could allow consumers to make better choices about the foods that they consume (Caswell and Mojduszka, 1996). Van Ravenswaay and Hoehn (1996) note that publicly provided information on food safety could result in changes in consumers' purchasing behavior and food preparation practices that would reduce the number of food safety incidents. Labeling and education would address the consumer's lack of information, which is one of the market failures that leads to food safety problems (Caswell and Mojduszka, 1996). However, education would not address the second form of market failure—that consumers demand less food safety than society would like (Golan et al., 2001).

⁴ Buzby et al. (2001) note that plaintiffs were hindered by long incubation periods for foodborne illness, a lack of food evidence, inadequate laboratory test results, and the fact that it is difficult to pinpoint which of many foods consumed caused the illness.

Government Regulation

When markets and legal institutions fail to provide the socially optimal level of some good, like food safety, economic theory suggests that governments can bridge the gap. Governments can take a number of policy initiatives to induce producers to provide higher levels of food safety. Governments could, in theory, tax unsafe food, raising the firm's costs of providing unsafe food and therefore creating an incentive to provide safer food. However, this assumes that a society can measure the amount of unsafe food that is sold, which would be difficult. Most governments, therefore, turn to regulation, setting minimum safety standards that food producing firms have to meet before they can sell their products.

Regulations are generally classified as product standards and process standards. *Product standards* specify characteristics that a product must attain before it is considered safe to sell. For example, most industrialized countries have maximum residue levels (MRLs) for pesticides. If a food has pesticide residues above this amount, a vendor cannot legally sell that food. In Great Britain, the government, under the doctrine of due diligence, assigns the responsibility for verifying food safety to food retailers, rather than setting specific procedures for processing foods.

Process standards specify techniques that must be used to process or package foods, with the belief that certain production techniques make food more likely to be safe. For instance, some governments require that processed meat products be raised to a certain temperature to kill bacteria before packaging. Ideally, such process restrictions are based on research, like studies of the percentage of bacteria killed at each temperature. In practice, such studies are not always available, although knowledge in this area is increasing rapidly.

Governments might have motives beyond food safety for certain regulations. Some food safety regulations also achieve some other purpose, like protecting the environment, animal welfare, or worker welfare. For instance, DDT was banned in the 1970s not only because the residue on foods was considered dangerous for consumers, but because the pesticide also bioaccumulated. Small animals ate sprayed plant life, fish that lived in streams absorbed runoff from farms, and larger animals that ate these small animals and fish accumulated huge quantities of the toxin in their tissues. In particular, eagles and other birds of prey were threatened by DDT, and since the ban, their populations have

recovered a great deal (Muir, 2001). In this case, a process standard (banning a particular production process) was used; simply setting a residue standard for food might not have met the environmental goal.

The Effect of Government Regulation on Supply

Are certain standards more costly than others? Economic theory indicates that product standards are often cheaper to implement than process standards, as product standards give firms more flexibility to choose the least costly production methods that meet the standards (Unnevehr and Jensen, 1996; MacDonald and Crutchfield, 1996). For instance, if a firm is told that its products cannot exceed a certain maximum level of pesticide residue, then it can choose the most cost-effective method for attaining that standard, which could include reducing the amount of pesticide applied, reducing the number of applications, switching pesticides, or altering the last date of application before harvest. If the government told the producer which of those methods to use, the government might not select the lowest cost method (Segerson, 1999). Indeed, one production method might be the low-cost method for one firm, while another method might be cheaper for another firm (Antle, 1996).

However, this general principle is not true in all cases. If one herbicide is banned because it is deemed too toxic, then producers might be able to switch to a similarly priced alternative. Additionally, standards for final products must be verified in some way, either by inspection or testing of samples, both of which can be costly, particularly in the case of pathogen contamination (Unnevehr and Jensen, 1996; MacDonald and Crutchfield, 1996). Hence, the relative expense of process and product standards has to be evaluated case by case.

In response to the relative expense of these types of standards, many countries are adopting HACCP requirements, which require firms to identify points in the production process where food safety is likely to be compromised, and to put in place procedures that prevent such compromise. HACCP requirements feature characteristics of both product and process standards. Firms must adhere to the procedures in their HACCP plans, but are allowed to define those procedures. Firms must also meet standards for pathogens in their products, and testing is required. Such plans have proven to be cost-effective (Henson and Caswell, 1999). These plans

allow the firm to choose the most cost-effective methods of prevention, and prevention can be less expensive than testing or remediating a product (Unnevehr and Jensen, 1996). Both the U.S. and the EU require producers of certain food products to implement HACCP plans.

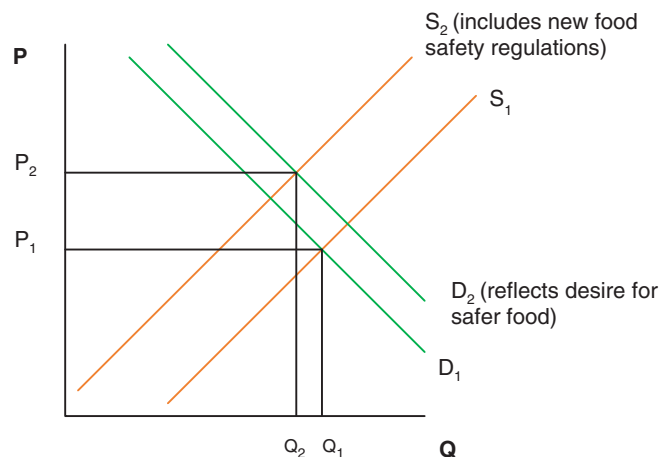
Whatever type of regulation the government chooses, most regulations will increase production costs for at least some firms. In isolation, these cost increases generally shift back the supply curve of a firm, which results in a new market equilibrium where firms produce fewer goods at a higher price. One could also say that less safe food was overproduced before the regulations were put in place, since the production costs that firms paid did not reflect the true cost to society of the less safe food, which should include the costs of illness, lost workdays, and other costs to society. Sometimes, industry opposes individual government regulations, which can increase costs and reduce production.

With regulation, however, consumers would be more willing to buy the food products, since they are now getting a safer good for their money (Unnevehr, 2000). This represents a shift out of the demand curve, with consumers now willing to buy more of the safer food and to pay a higher price. Indeed, fresh milk sales in the U.S. are probably much higher than they would be if consumers did not have the security of knowing that milk is pasteurized. However, the individual consumer is not able to capture all of the benefits of having the safer food; some of these benefits go to society. Therefore, in some cases, consumers might not be willing to pay as much as it costs for the product to meet the most socially beneficial safety standard. In such cases, the net effect would be a decrease in sales with a higher price, although this higher price better represents the true cost of supplying the food product with the higher level of food safety (fig. 2.1).

Additionally, firms have difficulty in passing on the information about food safety improvements to consumers. Some firms advertise when they undertake an improvement in food safety, even when such an improvement is a response to stronger regulations. After the *E. coli* O157:H7 incidents in the 1990s, some fast food chains sent out press releases announcing that they would be increasing the mandated cooking temperatures for their beef. Many juice companies now advertise the fact that they pasteurize their products. Firms are only required to label juices if they are unpasteurized, but firms label their pasteurized juices to reassure the consumer.

Figure 2.1

Market impact of a food safety regulation



Firms might also try to obtain third-party certification as evidence that they are complying with a particular set of safety standards. In other cases, particularly if the public is not aware of a food safety problem prior to the implementation of a regulation, or is unaware of the magnitude of the incremental increase in safety, then the regulation might not result in an increase in demand for the new, safer product.

Food safety standards affect not only the industry in which they are implemented, but also other related industries. If prices of a particular food rises, consumers might consume less of that food and increase their demand for another food, which will alter that second food's equilibrium price (MacDonald and Crutchfield, 1996). Suppliers to that industry might also find themselves subject to more stringent standards (Henson and Northen, 1998). Thus, the regulations might affect not only the market equilibrium in the regulated industry, but markets in other industries as well.

Food safety standards can also have implications for industry structure. If regulations require a large initial expenditure on equipment, such regulations might give a cost advantage to large firms that can afford this expenditure, and their scale means that the additional cost per unit is amortized over a large number of units (MacDonald et al., 1996). Firms might also integrate vertically (with retailers becoming processors and/or processors starting to run farms) in order to better control food attributes. Results here are mixed. Henson and Northen (1998) report that retailers tend to prefer asking processors for outside certification, as opposed to running processing firms themselves. Kilmer et al. (2001), however, report that vertical integration among straw-

berry producers is associated with lower pesticide residues, but the same is not true for tomato producers.

In order to decide whether or not to enact a particular food safety regulation, governments must weigh the costs to the firms and the consumers who now pay higher prices against the benefits to consumers, employers, and public health resources of improved food safety. Henson and Caswell (1999) point out that many governments have found this assessment difficult to achieve, given the wide array of standards to evaluate and the myriad of grounds on which those regulations are based.

Trade Implications

We have seen how concerns about food safety affect the domestic food production sector. Concerns about information, incentives for firms to provide food safety, and deviations of market outcomes from desired outcomes all affect the price, quantity, and qualitative attributes of food supplied. Firms may incur extra costs. Government regulation may prove necessary. How do those factors change when we introduce international trade into the picture?

Food safety concerns have some of the same implications for international trade as for domestic trade, but with the added complication that consumer preferences and government regulations may differ from country to country, creating the potential for rivalry and conflict. The 190 or so countries of the world all have established different regimes for food safety, and thousands of different foods are regulated. Differences in trade regulations can put either domestic or foreign firms at a competitive disadvantage in selling their products. Trade conflicts frequently result when countries enact different types of regulations, have different desired levels of food safety, or have different costs in complying with regulations. Countries can resolve these conflicts in a number of ways, including ceasing to trade, adopting each other's regulations, or recognizing each other's regulations.

Demand for Food Safety

Consumers throughout the world desire a safe food supply. However, the extent of that desire might differ from country to country. Consumers are also generally willing to pay more for safer food, but the amounts they are willing to pay might differ. Consumers in very poor countries might have to balance expenditures on

other health threats against that of food safety. Wealthy countries therefore sometimes have more stringent standards for pesticides and microorganisms than developing countries do.

Consumers might have different desired levels of risk. One country might want to push risk as close to zero as possible, while another might regard some slightly higher level of risk as acceptable, because driving the risk to zero would be extremely costly. Economists have found that the desire to tolerate risk varies significantly across individuals. Men tend to be less “risk averse” than women (Jianakopulos and Bernasek, 1998). Wealth tends to increase risk aversion up to a certain level, after which risk aversion declines with wealth, while the opposite is true for age (Halek and Eisenhauer, 2001). One’s perception of risk also depends on one’s ability to mitigate the risk or to cope with an adverse outcome (Smith et al., 2001). To the extent that such factors differ across countries, willingness to tolerate risk differs. Some studies of asset markets have found different levels of risk aversion in different countries (Hamori, 1998). Further, countries might have similar valuations of risk, but might disagree on what to do when the risks are unknown.

Consumers might also have difficulty making evaluations at very low levels of risk, which might lead to very different standards in different countries.

Implications for Firms

Firms still have incentives to provide safe food to consumers, even if those consumers are in a different country. Indeed, Holleran et al. (1999) note that there are incentives for foreign firms to provide safe food to capture international market share, just as there are incentives for firms to provide safe food to maintain domestic market share. If that incentive to provide safe food is large enough, firms might establish their own standards. This can be true as firms begin operating in an international arena as well. Firms can sell food abroad in one of two ways. They can open processing plants in other countries (often called foreign direct investment), or they can ship their food abroad (international trade). Raw and bulk food is often shipped. Some processed food is shipped, but a great deal is manufactured under license or by a subsidiary in the country to which the firm wishes to sell.

Foreign direct investment. As food processing firms open plants in many different countries, their private

standards might be modeled after their production facilities in wealthy countries (Reardon and Barrett, 2000). Nestle, for instance, sets stringent standards for suppliers to its plants that operate in a number of developing countries (USDEC, 2001).

These internal standards stem from the fact that firms desire reputations for food safety (Reardon, 2001). It is sometimes costly to communicate food safety attributes to the consumer, so firms might rely on their international reputations to do so (Reardon et al., 1999). However, since most of the food processing firms began in nations with stringent safety standards, the firms might simply be adopting stringent standards for their worldwide operations to reduce transaction costs by having standardized procedures. Whatever the reasons, the firms from wealthy countries that open branches in other countries usually do so to produce for the host country’s market, so the production at those facilities generally is not traded. The host country also has the legal right to impose food safety standards on these foreign-owned processing plants operating in their country.

Trade. Improving food safety standards can increase costs for firms. In addition to more expensive methods of production associated with food safety standards, trade also comes with some extra costs. Verifying that foreign countries have actually adopted the domestic food safety standards can be quite costly. Sending inspectors abroad is expensive, limiting the number of inspections an importing country can perform. If domestic governments inspect foreign firms, they can bear the costs, or they can bill foreign firms. If governments require foreign firms to obtain third-party certification, the costs will be borne by the foreign firms, but could be passed on to domestic consumers.

Foreign firms undertaking trade also undertake several risks as well. If compliance with the regulations requires a lot of fixed investment costs in the form of new equipment, foreign firms risk the investment without certainty of obtaining certification. In addition, even if they undertake certification, they might experience random transitory events, like disease outbreaks, that prevent them from complying with their trading partners’ food safety regulations for short periods of time.

The same problems that lead to a need for regulation domestically can lead to a need for government regulation in the international trade environment. Consumers do not consume as much safe food as society would like them to. Consumers also lack information about the safety level of the foods they eat, and the inability

of consumers to distinguish between safe and unsafe food can reduce the incentive for firms to provide safe food. Consumers might assume that if one firm's product is unsafe, all brands of that good are unsafe.

In the international arena, there are two complications to add. A firm's products might be labeled unsafe if some other firm has produced unsafe versions of that product, even if that other firm is in another country. California berry producers suffered a reduction in demand when consumers became ill from eating berries grown in Guatemala (chapter 5). Consumers could not differentiate the safe berries from the unsafe ones. Additionally, firms located in particular countries can find that their country's reputation matters in determining whether they can sell their goods abroad. Several studies indicate that consumers form opinions about the general quality of goods coming from a particular country (Chisik, 2002). When consumers receive inadequate information about the products they purchase, they can make errors that reduce their welfare, eschewing products they might really want to buy and embracing products that might be unsafe. Firms therefore lose some of their incentive to provide safe food, since they can spend money on food safety and still lose sales as the result of an outbreak. Conversely, they can spend little on food safety, and might not lose as many sales as they would if consumers knew their food was less safe. If a country's goods are perceived as poor in quality, there is less incentive for firms in that country to improve quality if they don't believe they can convince consumers to pay them the high quality premia (Chisik, 2002; Basu and Chau, 1998).

Government Regulation in the International Arena

These information shortcomings generally lead governments to regulate food safety. However, in the case of international trade, each country enacts its own unique set of food safety regulations. A country's ability to regulate firms outside its borders is limited to import restrictions. These differences in food safety regulations across countries can create conflict.

If governments impose regulations on domestic firms, and such regulations raise costs for producers, then producers might suffer a loss of sales. This problem can be compounded in the context of international trade. If domestic producers must adhere to regulations that raise costs of production, but foreign firms do not have to

meet the same requirements, then the foreign firms can offer their products at lower prices, undercutting the domestic firms and capturing a larger market share. Although consumers are willing to pay more for a safer good, if they cannot distinguish between the more heavily regulated, and presumably safer, domestic good and the less regulated imported good, they will not be willing to pay what the safer good is worth to them.

The amount of market share that foreign firms capture will depend on how willing consumers are to pay for the safer product, how well they can distinguish the safer product, and how well firms communicate to their customers that their products are safer. Figure 2.2 illustrates the case where the foreign supplier is not bound by the new stringent food safety regulations, but domestic producers are, so that the new domestic supply curve reflects higher costs.⁵ The demand curve remains unchanged, reflecting the assumption that consumers are only willing to pay more for a safer good if they can identify it. The result is a loss in market share for the domestic firm, and an increase in the cheaper imports. In such cases, consumer groups interested in food safety and domestic producers sometimes form political coalitions to pressure the government to impose the same standards on foreign firms as domestic firms (Vogel, 1995).

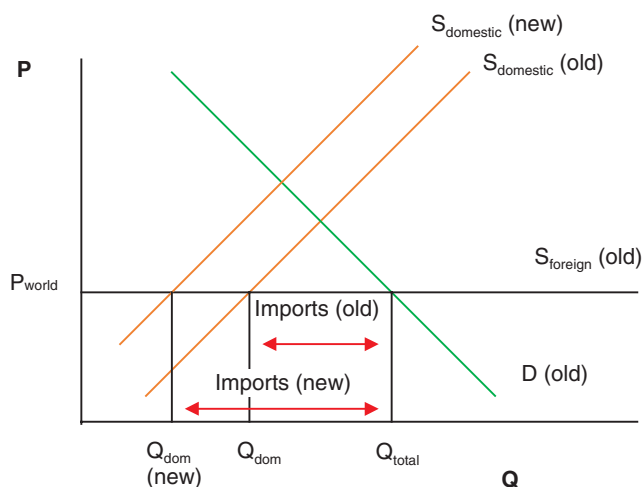
Indeed, governments already have a motivation to impose such standards, namely a safe food supply, whether foods are domestically produced or imported. Since governments do not have the power to regulate production in other countries, they usually set standards for imports that require foreign producers to meet the same product standards that domestic firms must meet or to prove that they use the same production techniques required of domestic producers. Foreign firms then have to pay the higher costs of complying with the standards, and might have to raise their prices, making their prices more similar to those of domestic firms.

Some governments have even set standards for particular foreign products higher than those for like domestic products. The foreign firms then must pay the higher costs of complying with the more stringent standards, and might have to charge a higher price than domestic firms. The foreign firms might even be kept out of the market altogether. Chile, for instance, has banned the import of fresh poultry. However, domestic firms are allowed to sell fresh poultry (see chapter 4). This prac-

⁵ Figures 2.2-2.3b reflect the assumption that the domestic country is a price-taker on the world market.

Figure 2.2

Foreign trade with a new food safety regulation affecting only domestic producers



tice protects domestic producers from foreign competition. Such practices are generally forbidden by World Trade Organization regulations, but enforcement of those regulations can be difficult.

Trade Conflicts

Many different trade conflicts over food safety regulations occur every year. It is difficult to determine how many trade conflicts occur every year or how costly those conflicts are. However, in 1999, almost \$400 billion worth of agricultural trade took place worldwide. Clearly, world food trade is not paralyzed by conflicts over food safety regulation. Some trade, however, could be inhibited by conflicts over regulations. Recent studies suggest that excessive technical barriers to trade, which include food safety regulations, might be responsible for measurable losses for agricultural exports from the U.S. (Henson and Caswell, 1999; Roberts and DeRemer, 1997). Other countries also experience losses.

Trade conflicts follow four common patterns. The first two stem from differences in preferences for food safety, and the second two stem from differences in the cost of providing food safety.

(1) *One country might use a process standard, while another uses a product standard, or each country might have different process standards.* While both product and process standards may result in a similar good or the use of similar production techniques, the fact that the requirements are different might result in

one country's exclusion of another country's products, or even mutual product exclusion.

Alternatively, one country might require the use of one process, while another country requires the use of a different process. The U.S. and EU, for instance, have different mandated standards for their meat producers. The U.S. requires producers to adhere to HACCP plans, and the government inspects the final product (FSIS, 1998). The EU also uses HACCP plans, but has very specific practices that it requires its meat producers to use, including checking pig hearts for a specific type of disease and mandating that meat casings be purchased from EU-approved firms (Caswell and Hooker, 1996; FSIS, 2002). While these two approaches can result in meat of similar hygiene levels, the production methods differ. In the early 1990s, this caused a great deal of trade disruption, as the EU revoked the export certification of many U.S. meatpacking plants (USTR, 1996). The EU also bans the use of hormones for growth promotion in livestock production, while the U.S. allows the use of some (see chapter 4).

(2) *Countries might have different levels of safety standards.* Countries have different levels of tolerance for risk, and they might have different levels of willingness to pay for a reduction in their risk of consuming unsafe food. Thus, one country might have a pesticide residue or bacteria level standard that differs from those of its trading partners. For example, the EU has recently adopted a very stringent standard for aflatoxin on peanuts that could substantially reduce African peanut exports to the EU (Otsuki et al., 2001). Indeed, countries vary widely in the actual levels of aflatoxin allowed on foods (see chapter 6). Also, countries might differ in their perceptions of the level of risk, particularly when risks are unknown, which can also lead to differences in regulations.

(3) *Complying with a safety standard might be more difficult for foreign firms than for domestic.* Several types of regulations can be more difficult for foreign firms to comply with than for domestic firms. For example, the importing country may have a regulation that requires inspection or certification by a domestic agency. In such cases, it can be very difficult and costly for a foreign firm to determine what the regulations are, comply with them, and then obtain inspectors from the domestic agency.

Additionally, a foreign firm might have particular local conditions that make complying with safety standards very expensive or even impossible. An exporting country

might use pesticides that aren't used in the importing country, and are therefore not approved there. The presence of BSE in Europe, for example, and the difficulty of testing for BSE, makes it difficult for a livestock producer in the EU to convince foreign markets of the safety of his or her product.

The costs and logistics of complying with food safety regulations might be prohibitive for firms in some countries. In developing countries, specialized equipment, industrial engineers, and local government inspection might all be substantially more scarce and therefore more expensive to obtain. Therefore, poorer countries might have greater difficulty complying with food safety regulations imposed by their trading partners (Unnevehr, 2000).

(4) A new safety problem might arise, or accidental contamination might take place. Countries might agree in principle on food safety regulations, but one country might suddenly have difficulty in complying with those regulations. In 1998, when dioxin accidentally contaminated a large quantity of animal feed in Belgium, thereby contaminating animal products, the U.S. banned imports of animal products from Belgium temporarily (see chapter 8). In such cases, countries might agree on acceptable levels of food safety, but it has suddenly become prohibitively expensive or impossible for one country to meet the desired standard. Interruptions of trade are often temporary, as the exporting country works to correct the sudden change in food safety. Conflicts can arise if the importing country and the exporting country disagree on the conditions that must be met for products to return to acceptable levels of food safety.

Consequences of Trade Conflicts

Countries can resolve their trade conflicts in a number of ways. The particular resolution chosen is often driven by the relative sizes of the costs of the regulations and the benefits of the trade flows. Three possible patterns of solving problems of differing standards include trade bans, adopting regulations of trading partners, or bilateral negotiation.

(1) Cessation of trade / trade bans. Some countries, unable to resolve their differences over food safety regulations, have simply ceased trading the product in question. This occurs if producers in the foreign country decide that the higher prices they can charge for

the safer goods in the highly regulated market of their trading partner are not enough to meet the costs of complying with those regulations, and if the demanding country is willing to forgo cheaper imports in favor of the greater perceived food safety it receives from the highly regulated domestic good.

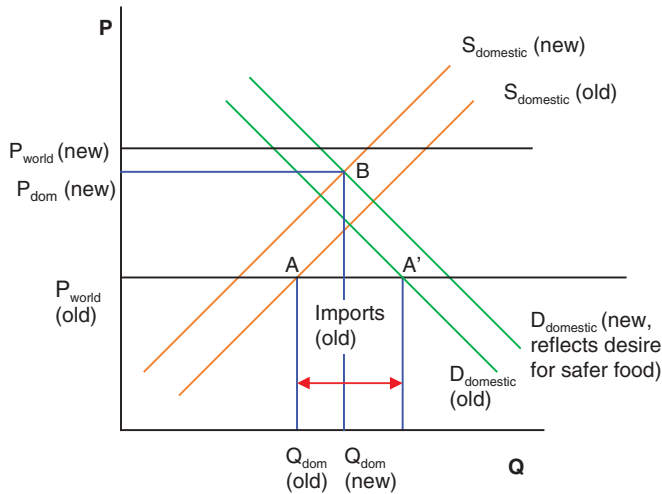
Trade might also cease for legal reasons if the domestic country imposes a trade ban. These bans might occur if, for instance, the gap between domestic and foreign regulations is simply too large to allow producers to satisfy both sets. For example, the EU refuses to accept U.S. chicken exports, treated with chlorine. The EU does not allow decontamination of poultry with chlorine while U.S. producers find it very difficult to meet stringent U.S. pathogen standards without the use of chlorine. A U.S. producer would find it difficult to comply with both sets of regulations. A country might also enact a legal trade ban when it feels that its trading partner cannot provide safe products at any reasonable price. For instance, the U.S. and many other countries have banned beef imports from Europe due to the presence of BSE.

When trade ceases, if the domestic country is not a major buyer of the good, then the foreign producers will sell their goods elsewhere. If, however, the domestic country is a major buyer, the demand for the foreign country's goods falls, reducing the price. In contrast, in the domestic country, reduced trade results in a reduction in the supply (domestically produced goods + imported goods) of the good, increasing the price. However, now consumers are presumably getting a safer good, as reflected by the new demand curve shown in figures 2.1, 2.3a, and 2.3b. If the foreign firm is really incapable of providing food of the desired safety level at an affordable price, then if the food safety gain is large enough compared with trade gains, trade should not take place. Additionally, if verification abroad or the risks of random safety crises prove to be too expensive for either the domestic or foreign party to willingly absorb, then trade might cease, because the domestic country is the lowest-cost producer of food safety and food safety information for that particular good.

In figure 2.3a, the domestic firm experiences the higher costs of providing the safe food. The increase in costs is even larger for the foreign firms, a fact that is reflected in the higher world price. The new higher world price, above the new domestic price, reflects the fact that other countries cannot supply the safer good at a price the domestic consumer is willing to pay. If the food safety gain is large enough, the domestic

Figure 2.3a

A new food safety regulation applies to both domestic and imported goods, but foreign firms cannot comply

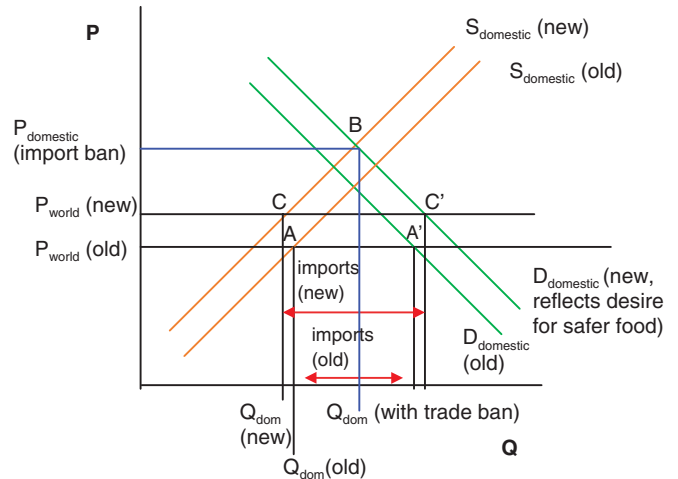


country will move from equilibrium point A-A', with imports, to equilibrium point B, with no imports.

In the case of a strictly legal trade ban—i.e., the foreign supplier could provide satisfactory goods, but does not because the two countries simply have regulations that differ—consumers are missing the opportunity to purchase the imported goods. When the domestic government implements the new food safety regulations, again, both domestic and foreign firms experience an increase in production costs. In this case, however, while the safer imported goods (sold at the new world price) are more expensive than imported goods that do not implement safety regulations (sold at the old world price), the imports are still less expensive than the domestic goods. The new world price is below the domestic price. Before the new food safety regulations, the domestic market imported goods from the foreign country because such goods had characteristics the consumers wanted at a price they were willing to pay. If costs increase by similar amounts, for both foreign and domestic consumers, and if extra costs for foreign producers are not high, then trade may still be beneficial. If the transactions do not take place because of a trade ban, both domestic buyers and foreign sellers usually lose. In figure 2.3b, this would be akin to consumers paying the higher domestic price rather than the new world price available with trade. Domestic consumers and producers move from equilibrium point A-A' to equilibrium B, at a higher price and lower quantity consumed (but a higher quantity domestically produced). Consumers would be better off with trade in the new, safer good at equilibrium C-C',

Figure 2.3b

A new food safety regulation applies to both domestic and imported goods, and both foreign and domestic firms can comply



with more consumed (but less domestically produced) at the new world price than at point B.

Ceasing trade or trade bans can be quite costly, although the total cost depends on a number of factors. If trade ceases because the foreign country is unable to supply a good of the desired safety level, then the citizens of the home country have decided that the costs are worth the benefits. The foreign exporters lose revenue, but can frequently sell the goods elsewhere for a lower price. If, however, the trade conflict represents a dispute over differences in regulations, rather than the inability to provide a safe product, then domestic consumers lose as well as foreign producers.

Private domestic firms can lobby for restrictions that keep foreign products out of the domestic market. If the costs of this lobbying are less than the market share that the domestic firm gains by keeping the whole domestic market, a firm has some incentive to do this. This kind of lobbying can therefore be costly to the domestic country, but only if the lobbying results in keeping out goods that would satisfy consumers' needs for safe food at a lower cost.

In many cases, however, legal trade bans or cessation of trade might well be transitory, particularly if the food safety problem is temporary. In such cases, the costs of trade exceed the benefits in the short run, but if the foreign country is able to mitigate the food safety problem, trade once again becomes beneficial, and lifting the ban results in greater benefits than costs. For instance, after the Belgian dioxin crisis, trade between Belgium and its

partners resumed (see chapter 8). The U.S. detains some seafood imports if testing indicates that they are tainted (see chapter 7). While costly for the individual importer and exporter, such episodes do not necessarily result in long-term losses to consumers and producers.

(2) *Foreign firms comply with domestic regulations or adopt domestic standards.* Some countries will simply comply with or adopt the standards of their trading partners. This can occur when a country cannot negotiate a reduction in standards, when a country can meet the standards set by its trading partner, albeit at greater expense, and/or when the higher standards give some kind of marketing advantage. In this way, firms in the foreign country find that keeping their share in the importing country's market, perhaps with a premium, is worth the costs of complying with the regulations. Such costs include not only the increased costs of complying with the regulations, but also the information costs of finding out what the regulations are, which can be high if the regulations are complex and very different from the foreign firms' own domestic safety regime. Verification costs and the risk of random food safety crises must be added to the costs of compliance and weighed against the gains of receiving high prices for safe food in the domestic market. In figure 2.3b, the market moves from the equilibrium A-A' to C-C', where the increase in world prices reflects the increased costs of the food safety standards. Consumers here receive the benefit of having both foreign and domestic suppliers of the new, safer food, which allows them to pay a lower price than they would at equilibrium B, which represents sales of the new safer food but without any foreign suppliers.

Any two countries, of any income levels, who have divergent regulations can and have used this strategy. However, Baldwin (2002) suggests that the dynamics of adopting similar regulations can depend on the parties to a trade dispute. When industrialized nations, each with their own standards, experience a conflict, it is difficult to get one to adopt the other's standards, so protracted negotiations can follow, and eventually they may recognize the equivalency of each other's laws. Baldwin further notes when one country is a developing country and one is an industrialized country, their laws might be too divergent to allow mutual recognition. Thus, the developing country will sometimes conform to the industrialized nation's standard.

Countries can agree to comply with the standards of their trading partners only for the purposes of export-

ing, or they can agree to adopt their trading partners' standards. The latter process is called harmonization (Hooker, 1999). Harmonization can also refer to two countries adopting a third standard, discussed below.

One of the more positive spillovers of having to meet stringent foreign standards for exports is improvement in the safety and quality of domestic production (Donovan et al., 2001; Vogel, 1995). For instance, if a firm operating in a developing country has to purchase state-of-the-art equipment in order to produce for export to wealthier countries with higher safety standards, then the food produced for the domestic market could also become safer. If the new equipment represents a one-time expenditure, the price will probably not rise substantially, and the safer food might be affordable. However, the safer food might be more expensive if the costs of running the machinery are substantially higher. In such cases, the firm might sell cheaper food domestically, using the less expensive, less safe production process (Donovan et al., 2001).

(3) *Bilateral negotiation.* Compromises can occur when countries each perceive that losing trade will be more costly than altering its standards or regulations. Negotiations take place between governments, since individual firms usually (although not always) have limited influence on another country's regulations. If a compromise is desired, countries have a number of options from which to choose. Either or both parties can attempt to recognize the other's regulations, hammer out a compromise, or adopt or accept international standards or standards set by a third party (see chapter 3; Henson and Caswell, 1999; Sykes, 1999; Dolan and Humphrey, 2000; Holleran et al., 1999; and Hooker, 1999). Two countries agreeing to adopt a third standard is one form of harmonization. Recognizing each other's standards is often referred to as "mutual recognition," while gradually moving standards closer together is referred to as "coordination" (Hooker, 1999). These three types of policy action all require at least one country to alter its standards in some way, incurring costs in order to keep the benefits of trading internationally for food. In one prominent case, the U.S. and the EU have arrived at an agreement that has allowed them to resolve some of their problems with conflicting standards for the safety of meat products. U.S. firms wishing to export to the EU may obtain certification from the USDA, thereby avoiding the costly overseas inspection problem. The USDA, in turn, certifies that the firms are using EU-approved production processes in addition to meeting U.S. domestic standards.

Common or third-party standards include those set by the Codex Alimentarius. Some countries have adopted some of the Codex standards. International standards would ideally seem to reduce the costs of negotiations over a bilateral standard. Indeed, Casella (2001) theorizes that when a number of countries with divergent standards begin to trade, they can benefit from adopting common standards, since it reduces the costs of conforming to more than one set of standards. Yet, she also points out that countries are better off with two sets of standards rather than one, so that they can appeal more exactly to the tastes of different sets of consumers. With two sets, each set of standards can be chosen to appeal to the tastes of a different set of consumers, while one set of standards might be rather far from the tastes of each set of consumers. Additionally, agreement on any third standard may itself be difficult and costly. Baldwin (2002) notes that trying to negotiate a solution in which the two parties agree on a third standard that both will adopt is rarely successful.

Rather, some suggest that mutual recognition of each other's standards is preferable, citing the fact that the EU member states found it much easier to recognize each other's standards than to agree on new ones that all would adopt (Baldwin, 2002; Vogel, 1995). However, if two countries are experiencing trade conflicts because they find their trading partners' standards do not satisfy their desire for reduced risk, mutual recognition is not necessarily an easy solution either. Indeed, economists have begun to recognize that individual consumers often require more compensation to give up a good once they have it, than they were willing to pay for the good in the first place (Kahneman and Tversky, 1991). Thus, if a country perceives that it is giving up a level of food safety that it has achieved, then they may be unwilling to compromise, even if the less expensive food they can purchase from abroad would appear to compensate them amply for a small reduction in food safety.

Bilateral negotiation will occur when a highly regulated country does not wish to lose a lower cost supplier, or fears that its trading partner might retaliate against a stringent standard with stringent standards or tariffs of its own. The domestic country must perceive these benefits from trade to be greater than any reductions in food safety they might incur with a less stringent standard, increased costs of verification under the new standard, or increased costs resulting from their own producers' having to alter their production practices. In

order to be willing to compromise, the foreign supplier usually must perceive that keeping their share of the home country's market is worth some potential increase in the cost of producing for the domestic country under the new regulations. Economic theory suggests that there are numerous possible solutions when two economic actors attempt to negotiate a contract. If the home country is an important buyer of the foreign country's products, then it is more likely to be able to exert influence and push for a supply of product closer to its own standard. If the foreign country is an important supplier of the good in question, then the foreign country will be able to exert influence in the negotiations, since it is likely that the costs of obtaining alternative supplies will be high for the home country.

Conclusions

As advances in science and increases in wealth put greater focus on food attributes, both firms and governments find themselves increasingly responding to consumer demands for food safety. Firms have incentives to provide safe food, but in some cases, the market and legal incentives are insufficient to give consumers the level of protection that a society as a whole would like. In such cases, governments enact food safety regulations, and at some point, the regulations of trading partners are bound to conflict, as countries choose different types of regulations and different levels of stringency from the wide array of options available.

When conflicts occur, countries may stop trading in some items, one or both countries may alter their standards, or they may maintain both standards. The option countries choose should depend on the cost of implementing the strict standards compared with the price that consumers are willing to pay for safe food, and also on country differences in the costs of complying with the new standards. If firms find it too difficult and costly to satisfy the demand of consumers in the markets of their trading partners, they might forgo trade or try to lobby for a change in their trading partners' regulations or a compromise solution. If, however, firms can charge an adequate premium in the market with more stringent standards, they might adopt the standards of their trading partners, which can, under certain conditions, eventually improve food safety in the domestic market.

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